

CIRCUIT FOR COMBINING AKB AND SELECTIVE BEAM CURRENT LIMITING AND
PROJECTION TELEVISION SYSTEM UTILIZING SAME

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Related Application

1 This application claims the benefit of U.S. Provisional
2 Application No. 60/275,722, filed March 14, 2001, Attorney Docket
3 US010067P.

Background of the Invention

4 The invention relates to projection television systems
5 including three separate cathode ray tubes (CRTs), and more
6 particularly, to circuitry for combining automatic kinescope bias
7 (AKB) circuitry with circuitry for sensing and limiting average
8 individual beam current sensing.

9 Many CRT-based video display systems employ an automatic
10 kinescope bias (AKB) control systems for maintaining proper black
11 image current levels for each electron gun of an associated image
12 displaying kinescope or CRT. The purpose of such AKB control
13 systems in a CRT is to prevent the displayed picture colors and
14 picture grey scale information from being adversely affected by
15 variations in the kinescope bias due to such factors as aging,
16 temperature changes, etc. Conventional AKB control systems include

1 a beam sampling element coupled to a control amplifier in each AKB
2 feedback loop for automatically adjusting the kinescope black level
3 of the electron gun. Adjustment is implemented typically during
4 the blanking period to prevent variability of the black level
5 sampling pulses.

6 A conventional AKB control system used in a video display
7 system is disclosed in US Patent No. 4,633,321 ("the '321 patent").
8 The '321 patent discloses an apparatus for automatically
9 controlling the bias of an image display device such as a kinescope
10 in a television receiver. The '321 patent apparatus comprises a
11 grid system responsive to a grid drive signal in order to prevent
12 visible artifacts during non-blanking AKB operating periods. More
13 particularly, the kinescope electron gun is caused to conduct a
14 white-going current during plural horizontal line intervals in
15 response to the grid drive signal applied to the kinescope electron
16 gun during a given portion of the AKB bias monitoring interval.
17 The drive signal is blanked during horizontal retrace intervals to
18 eliminate the white current at such times, thereby eliminating
19 visible horizontal line retrace artifacts which would otherwise
20 appear to the uncorrected retrace pattern of planar kinescope.

21 US Patent No. 5,488,417 ("the '417 patent") discloses an AKB
22 system which avoids the need for grid drive circuitry to prevent
23 visible artifacts. The '417 patent uses a controllable current
24 source in an AKB circuit to apply a measurement current to a

1 kinescope driver amplifier during selected lines of the vertical
2 interval of a video input signal. The amplified current signal
3 induces a beam current in a kinescope coupled to the driver
4 amplifier. A comparison circuit compares samples of the beam
5 current obtained during the selected lines with a reference signal
6 and applies a correction current to the driver amplifier for
7 regulating a parameter, e.g., black level, of displayed images
8 based on the comparison.

9 A signal source, coupled to the controllable current source,
10 inhibits production of the measurement current during retrace
11 portions of the selected lines and enables production of the
12 measurement current during trace portions of the selected lines.
13 The benefit of such a construction is that use of the signal source
14 provides for suppression of visible artifacts due to AKB operation.

15 US Patent No. 6,188,435 B1 discloses a circuit for controlling
16 beam current using current "pictures" for the R, G, B beam currents
17 in the kinescope or color picture tube. The means for
18 accomplishing the beam current control monitors each individual R,
19 G and B beam current individually to maintain its corresponding
20 picture sharpness and/or peak white maximum beam current, average
21 beam current values per line and per picture. The current pictures
22 correspond to the real currents in the color picture tube, the sum
23 of which is compared with beam current information obtained from
24 the associated high voltage transformer to both correct

1 fluctuations in the millisecond range and long-term drifts. Use of
2 the current pictures enables the beam current control to quickly
3 regulate picture sharpness for the three R, G, B colors as well as
4 total beam current in the picture tube.

5 In order to generate the current pictures, the beam current
6 control circuit taps or clamps the R, G, B signals in an amplifier
7 including a controllable gain, amplified and weighted by means for
8 gamma correction. The real current ratios in the picture tube are
9 simulated in the current control circuit by the gamma correction
10 means. A weighted sum is formed of the signals and serves as a
11 comparison value with respect to a beam current information value,
12 I_{crt} . The two information signals are compared, and an output
13 signal is generated by the comparison. The output signal is used
14 to control the gain of the amplifier. The current control circuit
15 thereby monitors the values of each individual R, G, B signals to
16 regulate the R, G, B beam currents and picture sharpness, and the
17 weighted sum together with the output signal of the control circuit
18 are monitored by a decision circuit.

19 In projection television display systems having three separate
20 CRTs for producing R, G, B light, certain signals such as a high
21 level flat field in an individual primary color can result in the
22 respective CRT providing much more than its nominal share of light.
23 While it is common practice to sense and control the total beam
24 current, under such flat field conditions, one CRT may draw most if

1 not all the beam current ordinarily allocated for all three CRTs.
2 When this occurs, overheating and fracturing of the CRT may occur.
3 This is particularly troublesome in the case of video accessory
4 devices which provide a blue flat field when no program content is
5 being provided.

6 To accommodate these undesirable signal conditions, it would
7 be effective to determine the relative share of current provided to
8 each CRT. In the prior art, for example, in a Philips/Magnavox GR-
9 9D, the cathode current of the blue CRT is directly measured, with
10 the preceding R, G, B video gains controlled to limit the average
11 blue current to a safe level. The skilled artisan, however, will
12 realize that it is also desirable to utilize individually sampled
13 cathode currents for automatic CRT cut-off stabilization, that is,
14 automatic kinescope bias (AKB) control.

15

16 Objects and Summary of the Present Invention

17 Accordingly, it would be a welcome advancement for those
18 skilled in the art to realize a circuit and method which allows the
19 sampled current to simultaneously supply both the AKB control
20 circuitry and blue drive limiting circuitry, with no interaction
21 therebetween.

22 It is therefore an object of the present invention to provide
23 a control circuit which monitors the average blue beam current, and
24 determines if that blue beam current exceeds a predetermined

1 threshold, introduces a gain reduction in preceding video gain
2 stages to limit the blue beam current, and which, depending on the
3 determined magnitude of the blue beam current, may deploy either
4 AKB or selective beam limiting without the use of special timing
5 signals.

6 To that end, the present invention discloses a control circuit
7 for use in a video processor which utilizes combined automatic
8 kinescope bias (AKB) control, and average individual beam current
9 sensing and limiting in at least one CRT. The control circuit
10 includes automatic kinescope bias (AKB) control circuitry for
11 detecting a magnitude of individual red (R), green (G) and blue (B)
12 cathode currents driving corresponding R, G and B CRTs, generating
13 at least one of R, G and B average cathode current control signals
14 therefrom, and using at least one of the R, G and B average cathode
15 current control signals as a feedback signal to the video processor
16 to reduce the R, G and B cathode currents approximately equal
17 current amounts. Selective beam current limiting circuitry within
18 the control circuitry compares at least one of the R, G and B
19 average current control signals with a predetermined signal, and
20 whereupon the at least one of the R, G and B average current
21 control signals exceeds the predetermined signal, introducing a
22 gain reduction in corresponding video gain stages within the video
23 processor to limit the at least one of the R, G and B average
24 current control signals.

1
2 Brief Description of the Drawing Figures

3 The above and other more detailed aspects of the invention
4 will be described in detail hereinafter, by way of example, with
5 reference to the following drawing figures.

6 Fig. 1 is a schematic diagram of a conventional Automatic
7 Kinescope bias (AKB) control circuit;

8 Fig. 2 is a schematic diagram of one embodiment of a circuit
9 of this invention comprising both AKB circuitry and average beam
10 current sensing and limiting circuitry; and

11 Fig. 3 is a schematic circuit diagram of a proprietary video
12 board which implements the function of the present invention.
13

14 Detailed Description of the Preferred Embodiments

15 The reader should note that the embodiments described herein
16 are for exemplary purposes only, and are not meant to limit the
17 scope and spirit of the invention at all. Only the language of the
18 claims appended hereto shall limit the scope and spirit of the
19 invention.

 Prior art Fig. 1 shows a video processor with conventional and
automatic kinescope bias control. More particularly, the video
processor generates and outputs a red (R), green (G) and Blue (B)
cathode current signals. The blue cathode current signal is
supplied to NPN emitter follower Q4, the collector current of which

drives PNP emitter follower Q5. The red cathode current signal is supplied to NPN emitter follower Q9, the collector current of which drives PNP emitter follower Q10. The green cathode current signal is supplied to NPN emitter follower Q14, the collector current of which drives PNP emitter follower Q15. Emitter currents of Q5, Q10 and Q15 drive CRTB, CRTG and CRTR, respectively.

Collector currents of Q5, Q10 and Q15 are fed back to the video process which, using DC bias control, maintains equal near-black currents, i.e., the blue, green and red video processor outputs shown. The present invention exploits the presence of one at least one of the three currents flowing in through the collectors of respective PNP transistors Q5, Q10 and Q15 to additionally detect average CRT cathode beam currents and determine if they exceed a specific (appropriate) current level. If the particular CRT beam current exceeds the specified level, video drive circuitry is provided with a control signal to control and limit the current level.

Figure 2 shows a first embodiment of a control circuit of this invention. The Fig. 2 circuit adds average beam current sensing and limiting circuitry to the conventional AKB circuitry shown in Fig. 1 and described above. Only the additional circuitry for one of the driver currents, that is, the blue current is shown and described in order to simplify the drawing and explanation.

The collector current passing through PNP transistor Q5 is

approximately equal to the transistor's emitter current driving the blue CRT. The cathode current is therefore returned through resistor R1, PNP transistor Q1 and diode D1 to the AKB feedback port of video processor V2. The voltage drop across R1 is proportional to the average blue beam current. When the voltage drop across R1 exceeds a predetermined threshold current determined by the voltage across resistor R2, PNP emitter follower Q2 and NPN emitter follower Q3 conduct and introduce gain reduction via video gain circuitry internal to video processor V2. Resistor R5 is connected in parallel with a capacitor C2 to provide low pass filtering means to filter the signal driving NPN transistor Q3. The currents output from the blue green and red ports of the video processor are limited thereby. So, depending on the magnitude of the current, either AKB or selective beam limiting is deployed by the inventive circuit without a need for additional special timing signals.

The above-described circuit may be used successfully in a projection television display system with three separate CRTs for producing red, green and blue light (signals).

Fig. 3 is a schematic diagram showing a production design of a video processing circuit which implements the concept of this invention, that is, utilizes sampled CRT cathode beam current for both automatic cut-off stabilization and drive limiting circuitry without interaction. One portion of the video processor circuit,

portion A shown enclosed by the broken line of Fig. 3, implements the control circuit of the invention.

Portion A performs an equivalent function of the inventive circuitry shown in Fig. 2. The reader should note that portion A only highlights the blue drive portion of the circuitry, as is the case of Fig. 2.

In portion A, PNP transistors 7614 and 7615, and NPN transistor 7616 correspond to PNP transistors Q1 and Q2, and NPN transistor Q3 as shown in Fig. 2. Resistor 3665 and capacitor 2625 correspond to resistor R5 and capacitor C2, resistors 3663, 3666 and 3664 correspond to resistors R2, R3 and R4, resistor 3669 is used in lieu of diode D1, and resistors 3667 and 3668 are included in Fig 3, but not Fig 2, and low pass filter combination R1 and C1 of Fig. 2 is not included in Fig. 3. The current flowing at node F616 is equivalent to the current flowing in the collector of PNP transistor Q5.